Water problem in the UAE mountain areas: A case study on the east coast farming areas

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Abstract. As a result of the recent unwise use of water pumped from underground resources, several East Coast (EC) farms (70%) became appended by farmers in the UAE mountain areas. The EC of the UAE is one of these areas where farmers can't utilize their farmland because of the increased salinity in irrigation water. This problem increased at the end of the last century as a result of the increased population and the expanding area of EC cities which put more pressure on the existing underground water resources. This paper highlights the main reasons behind this problem and examines both the government and the EC farmers' efforts to reduce the impact of water shortage on EC farming activities. Farmer's points of views were collected through direct personal contacts to evaluate the nature and the volume of this problem. Future alternatives are suggested to help in reducing the effect of water shortages on the farming activities in the EC of the UAE.
Keywords: water problem, mountain areas, irrigation system, government supports

Introduction

The East Coast (EC) mountain areas cover around 5% of the total United Arab Emirates (UAE) land. Most of these mountains areas spread through the northern part of the country from Ras Al Khaimah and Fujairah to the Hatta area. These mountain areas lay in a harsh environment with limited sources of water and high temperature, and a high percentage of humanity (EAAD, 2010). Historically, most of the mountain dwellers practiced farming activities to survive during the pre-oil era. The EC is only 90 Km long and its width ranges from 0.1 Km to 12 Km in some areas. These farming areas used to supply most of the country's residential areas with farm crops. There is no surface running water except some Wadis, following the short rainy days during winter months, with less than 110.5 mm of annual rainfall. Indeed water problem is not new to the area; it started at the end of 1970s followed the establishment of the UAE Federation on December 2 1971. As a result, the UAE witnessed hurried modernization of its infrastructure which in turn brought large numbers of overseas workers to settle down in the area. As a result the UAE population increased from around 1 million at the end of the 1970s (Peck, 1986) to more than 8 million in year 2010 (www.uaestatistics.gov.ae). This population growth added more pressure on the already acute water problem resulting from the limited underground water resources. Also the increase population has increased the demand for quality and quantity of agricultural products (Fraiture, & Wichelns, 2010).

So this new situation forced the farmers to share the limited underground water which used to be devoted to farming activities. In 2010 there were 5,528 farms in the EC with a total area of 73,461 Dunom (one *Dunom* equals 1000 square meter). At the same time more than 16 % of these farms (890) are inactive and cover 12,950 Dunom. Most of these farms are facing water problems due to the quantity and quality of irrigation water.

In 2012 there were 4 main sea water desalination plants producing more than 20 million gallons of water to cover the urgent needs of the EC of drinking water. These stations produce water for housing and industrial uses only, and leave limited underground water recourses for irrigation of the EC farmland. There are several studies which covered the shortage of water in the UAE e.g. (EAD, 2006), (Global Water Intelligence, 2010) and (Szabo, 2011). Also the study of (Johnson, 2000) and (Jain, & Singh, 2010) focused more on the water crises and governmental policies to manage water irrigation in deferent areas. Some of these studies dealt with the water problem in the whole UAE while focusing more on the main UAE cities e.g. Abu Dhabi, Dubai and Sharjah.

There is a limited literature about the effect of water problem on the EC farming areas. This paper focuses on the main problem of the water shortage in the EC and how it affects the farming activities in the area. It highlights the future alternatives to water problems in the EC farming sector. The researcher managed to visit most of EC farmland and conducted direct interviews with some of the local and expatriates labor force and EC farm owners (280 cases) to

answer the main question of how the water problem affected the farming sector in the EC. Most of data used in this paper is driven from the Ministry of Environment and Water (MEW) database and personal contact with some of the EC farmers from direct farming areas. Also some information gathered from other resources e.g. local municipalities.

Evaluation of the EC current farm water problem

There are some government efforts to reduce the impact of the water problem on the EC inhabitants, but the farming sector still requires more attention from the government. Due to the shortage of water problem data as well as its impact on the farming activities in the EC, it is difficult for the researcher to find out what exactly happened in this situation. So far the MEW is one of the Federal agencies that deal with the farming activities in the EC beside some other local parties. Unfortunately, there is no updated data for the numbers of active and inactive wells and farms in the EC farming areas. Presently the number of EC farms is calculated by constantly adding new farms to the old farm records. No data is incorporated into this total to account for the nonoperational farms or those no longer in existences due to land being swallowed up by growing EC residential areas. The same can be saying for the water wells.

Most of the farmers in the area complain about the water problem as the main problem facing their farms. It is clear that an estimate of 90% of the total EC farmers have water problems either in the quantity or the quality of irrigation water in their farms. The government record shows that the total number of farms increased from 2525 in 1975 to 5528 farms in 2010. These figures show the total number of farms recorded at the MEW, but there is no record for the number of the farms that are converted to other uses as a result of the expansion of the EC cities which converted farmland to residential areas and new infrastructure e.g. schools, housing and roads. Table: 1 illustrates that the number of farms reached its peak in the year 2000 and then started to drop down. This also affected the crop land and the total farmland in the EC. As reported by farmers during the interviews, the water problem is the main cause of this drop in the number of these farms.

Table: 1 Number of farms and total farming areas in the EC from 1980-2010

Year	Farm	Cropped land	Total Area
1975	2525	9212	23709
1980	4591	31656	36131
1985	4720	29678	44342
1990	5461	56542	58234
1995	5574	56688	58363
2000	5940	83847	85651
2005	5547	60198	76772
2010	5528	49928	73461

Source: MEW, 2012 (data collected from several MEW records)

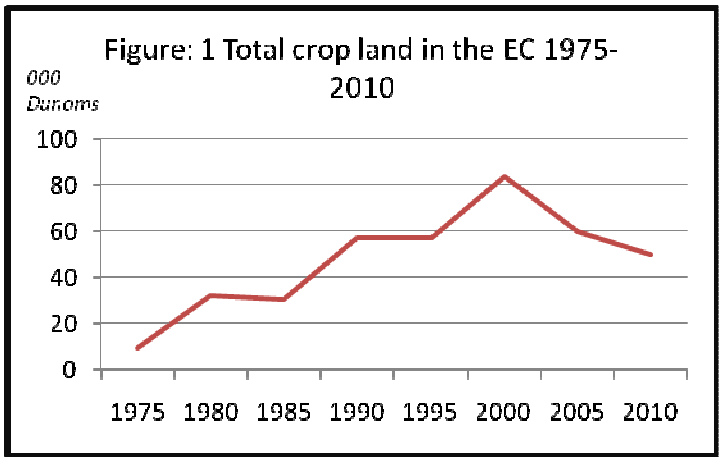

Figure 1. Total crop land in 1975-2010 in UAE

Water problems impacted the EC farming sector severely after the 1980s when the area of crop land increased from 9,212 *Dunoms* to more than 31,656 *Dumoms.* In 2000 the area of crop land increased again to 83,847 *Dunoms* of the total farming land. Most of the farmers used to grow vegetables and fruits trees. Crop land requires a large volume of water for irrigation. Crop land decreased to 49,928 *Dunoms* in 2010 as a result of the water shortage and the increase of the water salinity in most of the EC farm wells (Figure 1). The government used to help the farmers to build their wells in their farms free of charge. For example, in 1980 the government dug 83 wells free of charge for the EC farmers, but 5 years later the government reduced this number to only one well dug in the whole EC farming area (MAF, 1982).

Also, the UAE Federal government launched Federal Law Number 21 in 1981 to establish the General Authority of Water Management in the UAE; this agency organizes the use of water resource in the whole country. In 2011 the total number of EC farming wells was estimated at 5,272 water wells, of which 23.1% were inactive (Table: 2). At the most active time there were 4,050 active wells in the EC and 90% of these wells operated with limited water or increased water salinity. This of course affected the type of farm crops grown in the EC farms. The EC used to be the main supplier of mango and tomato products to the all UAE regions. Now less than 15% of the tomatoes consumed in the EC are harvested from the EC farms.

Table: 2 Estimated distribution of farms and water wells in the EC in 2011

Region	Well		Farm	
	active	inactive	active	Inactive
Dhadnah	400	250	330	170
Dibba	1150	70	1000	54
Fujairah	280	150	450	40
Kalba	870	400	528	330
Khor Fakkan	350	230	420	474
Massafi	490	97	1100	70
Murbih	510	25	300	190
Total	4050	1222	4128	1328

Source: MEW, Eastern Region Administration, 2012

Generally, it is clear that the water problem was caused by many reasons;
(a) Increase in the EC population from 40 thousand at the end of 1970s to more than 230 thousand in 2011 leading to the increase use of the water for domestic uses; (b) More than 55% of the EC farms still use the old traditional irrigation method of flooding which consumes large quantities of water as a result of high evaporation especially during the summer months; (c) Most of the EC farm labor forces are coming from the Indian Sub-continent where water is not a serious problem so they are not familiar with the EC water problem; (d) The government did not succeed in encouraging the use of the modern irrigation system in most of the UAE farm land as a result of the high cost and required engineering monitoring.

The water problem affected not only the farm owners, but also the EC markets. In the past most of the farm crops e.g. vegetables and fruits used to be grown and harvested from the EC and sold at the local markets in the EC. Nowadays only 10% of these products are grown at EC farms while the rest are imported from overseas markets.

The government efforts

Although the UAE government represented by the MEW diligently strives to organize the farming activities and monitor the wells dug in the EC, most of the farmers are not used to getting a government permit before digging water well on their farms. In fact, until the late 1990s no government permit was even needed for well digging. Now the government puts more

restriction on the wells digging companies as well as on farmers to control the number of wells dug in the EC farming areas.

In addition, the Ministry of Agriculture and Fisheries (MAF) (recently called Ministry of Environment and Water) introduced the new irrigation system at the end of 1970s to reduce the use of water in the EC farms. Also, the MEW engineers try to visit the EC farms and provide some help to the farmers by introducing new farming techniques and new irrigation methods. For example, growing crops in greenhouses using drip and sparkly irrigation methods can save 60% more water over traditional irrigation. As a result of ongoing monitoring and education by the MEW during 2011, there were more than 1,267 EC farms using new irrigation systems to irrigate their farm crops. At the same period the total area of the EC farms using new irrigation systems reached 21,010 *Dunoms* out of the total 50,182 *Dunoms* of the EC irrigated areas. This means almost 42% of the total EC farmland was using new irrigation systems, while the remaining areas still using the old traditional irrigation method of flooding continued to consume large amounts of water.

Farmers' points of view

The majority of the farm owners in the EC are not relying on farming activities as their main source of income. They also work in the government or private sector jobs and in their afternoons they try to manage their farms. 80% of the farm owners depend mostly on farm expatriate labor force to manage their farms. 90% of the farmers are facing the water shortage problem on their farms, and they are suffering every day to find water to irrigate their farm crops.

During the interviews they spoke out about their water problems and how they cannot see any short term solutions. Many of the EC farmers carry water in their own cars from their houses to irrigate their farm crops each day; the trips cost them additional money and efforts. More specifically, these daily trips require buying a new truck equipped with a water tank and taking the time fill the water tank. Some of these water tanks require 10 hours to fill up from the government provided water in their houses. In turn this reliance on the government water supply puts stress on the community water supply. Once the farmers reach their crops there is the additional time spent to irrigate the crops with the water they hauled. Added to this time consuming process is the resulting high cost of their home water bills. Even those farmers, who dug wells at their houses to get water with less salinity, cannot irrigate all their farm crops because some of the vegetables e.g. tomatoes, cucumber and eggplants can't tolerate even the lower water salinity. So, most of those farmers use this water quality to irrigate palm trees only. Some of the house water well salinity could reach 8 thousands parts per million (chemical analyzing 8000ppm).

Their water problem increased in recent years as a result of the increased water salinity in their farm' wells. This problem forced many of the EC farmers to install machines to purify the irrigation water thus reducing the water salinity from their farm wells. These temporarily solutions are not affordable by many EC farmers. Even those who installed this equipment did not get excellent results. Many of interviewed farmers complained about the limitation of water amounts that can be achieved using water purifiers since the average purification machines can purify only 1000-2000 gallon/day. Also, this equipment is costly and needs constant maintenance and monitoring which adds more burdens to the farmers. As helpful as the purification equipment can be, using these machines resulted in creating another problem. There is no economical, environmentally safe way for them to dispose of the highly salted discharge water from the purification equipment. Some of the farmers who installed this equipment also realized that their farm water depleted in a short time.

Future EC farming alternatives

The farming sector is facing a major problem: water shortage. For the EC farmers to continue their farming activities the government should take steps to support the farmers not by providing them with financial support, but by implementing a future strategy to make sure that the EC farm land is used wisely and practically by the local farmers. Furthermore, sustainable farming using new techniques and modern irrigation systems could keep the farmers working at their farms by insuring an extra income from growing farm crops.

Sea water desalination

Since the EC land is located on open water outlets, outside the Strait of Hormuz, its sea water could be used to irrigate the farm land to replace the depleted underground water

resources. In particular, the EC has the biggest desalination sea water plant in the whole UAE and the Middle East which produce 130 million gallons of water daily with a total cost of USD 2.8 billion (Al Bayyan, 211). So far most of this water is transferred by pipeline over more than 200 km to other UAE regions. The government could direct small portions of this water to irrigate the EC farms. Most of the interviewed famers (60%) are willing to pay the bill and this water could bring life back to many EC abandoned farms.

Water from sewage treatment plants

In 2010 there was one major sewage water treatment station operating in the EC which could purify 7 million gallons daily. This station provides service to half of the EC area (Al Rroya. 2010). The amount of sewer water to be treated could be increased in the future to provide coverage to all EC areas. The treated water could be another source of irrigation water to irrigate the EC thirsty farms. This source of water could be transferred to the EC farmers if the government injects this water into wells dug close to the farming areas so that the underground water level in some dry farming wells would increase. In this case treated water will be naturally treated by filtering through the ground before it reaches the farm crops. Another idea would be to use this source of water to irrigate the green landscape in the EC areas and leave the underground water and the desalinated water to be used for farming and other housing uses.

Types of farm crops

There are several types of farm crops that can tolerate the high water salinity e.g. palm trees, halophytes and other plants. The MEW' engineers could create a list of farm crops such as these that are suited to the EC climate and can be grown with less water, higher salinity and higher temperature. Also, the government could introduce incentives by purchasing the farmers' products and granting economic subsidies to encourage the EC farms to utilize all of their farm land and in doing so use less water to irrigate their farm crops. According to the MEW engineers, palm trees can tolerate water salinity with 13,000 ppm, but limes can only survive with water salinity between 2,000-3,000 ppm. Figure: 2 shows that over the years palm trees would always survive the amount of salt in the irrigation water since at no time did the salinity exceed 10,000 ppm. Limes, however, would constantly struggle to survive and produce fruit during every year that was reported.

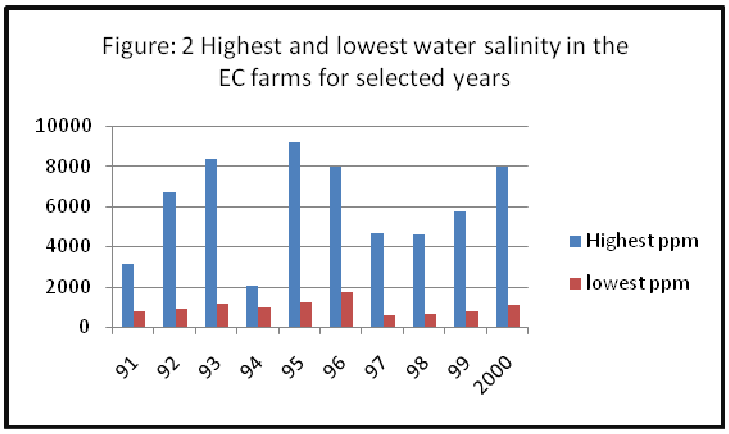

Figure 2. The water salinity in the EC farm for selected years

Modern Irrigation System

Using modern irrigation systems could be another alternative to reduce the amount of water use in the EC farms. In 2010 only 23% of the total EC farms were using modern irrigation system. Of that 23% bubbler irrigation was used to irrigate 59% of the total farm land (Figure: 3). At the same year 42% of the total EC irrigate areas were irrigated by modern irrigation system. With government encouragement this percentage could be raised to reach at least 90% in the next five years. The government could reach this target by increasing the farmers support by providing free installation of most efficient irrigation systems and help in purchasing these equipments from the local and international markets.

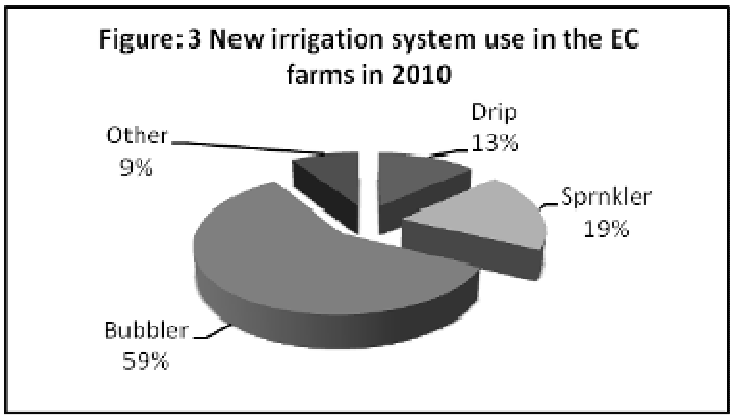

Figure 3. New irrigation system in EC farm in 2012

Green houses and Marketing

Growing crops under a controlled environment could be another alternative to increase crop output in the EC. One of these techniques is growing farm crops in cold greenhouses. In 2010 there were 1,164 greenhouses in the EC covering an area of 385 *Dunoms*. This technique reduces the amount of water used for irrigation and limits the number of laborers needed compared to farming in an open field. At the present time this type of farming is facing some obstacles in the EC farmland located close to the sea water bodies. With a high average humidity 60-80% and a high temperature during the summer months most of the current techniques used in the cold greenhouses are not productive in growing certain crops e.g. tomatoes, squash and herbs. If the government could use alternative techniques to control the high humidity and/or use other types of radiators then the use of cold greenhouses would become more feasible.

Marketing of the EC farm crops is another challenge facing the farmers. Introducing organic food and government guaranteed pricing could encourage EC farmers to grow certain crops that are monitored by government agencies. On top of that, the government could buy the farmer's products and resale them to consumers through collection centers to save the EC farms' efforts and guarantee better prices for their crops.

Conclusions

EC farming activity is facing major obstacles in water quantity and quality. These problems affect the type of farm crops grown in the EC farmers. Due to increased EC population and the increase demand on water supplies for irrigation, the government should use sea water desalination plants to provide water for irrigating EC farms. Most of the farmers are willing to pay higher prices in the form of a water meter tariff in order to take care of their farm crops.
Future collaboration between various parties such as government agencies and the local farmers is needed to continue the EC farming activities and sustain the farming environment in the area.
Using certain types of vegetables and other farm crops could reduce the use of water and save water to irrigate the EC farms.

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